Ag Water Conservation Offset Program PRGWB Final Report

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Acronyms

AC	Acre
AF	Acre-feet
AFY	Acre-feet per year
CIMIS	California Irrigation Management Information System
DWR	Department of Water Resources
ER	Effective rainfall
ETc	Crop evapotranspiration
ETo	Reference evapotranspiration
FAO	Food and Agricultural Organization of the United Nations
FP	Frost Protection
GIS	Geographic Information System
IE	Irrigation Efficiency
LR	Leaching requirement
NOAA	National Oceanic Atmospheric Administration
RCD	Resource Conservation District
PRGWB	Paso Robles Groundwater Basin
Q	Pumping rate
S	drawdown
SLO	San Luis Obispo
T	Transmissivity
WPA	Water Planning Area
W(u)	Well function

SECTION 1. PROGRAM DEVELOPMENT

1.1 Introduction

Water is a precious resource in nearly any community. In the Central Coast of California, which experiences semi-arid Mediterranean climate, the variability and, thus, reliability of water is a matter that seems to polarize communities. To further complicate matters, in San Luis Obispo (SLO) County, the distribution of precipitation decreases from the coast to inland areas as the coastal range of mountains create a rainshadow effect to inland basins (NOAA 2014). In SLO County, the Upper Salinas River basin is one of the largest basins in the State, that begins at the confluence with the Nacimiento River near Bradley and extends several miles southeast of Santa Margarita. The Upper Salinas Basin is mostly unregulated, except for a large dam, the Salinas Dam, forming Santa Margarita Reservoir. The Salinas Dam, built in 1941 by the U.S. Army Corps of Engineers, provides flood risk management and a source of water supply to the City of SLO (City of San Luis Obispo 2014). Downstream of the Salinas Dam, groundwater is the primary source of water supply to the inhabitants in the outlying rural areas and the unincorporated towns of Santa Margarita, Templeton, and San Miguel, Creston and Shandon in addition to providing municipal supplies for the cities of Atascadero and Paso Robles. It is also a major source of supply for irrigated agriculture throughout the region. The Upper Salinas Groundwater Basin is fed not only by the Salinas River but underlies areas supported by infiltration from numerous tributary rivers and streams such as the Estrella and San Juan Rivers.

In the Upper Salinas Basin, multiple municipalities and a wide range of landowners extract groundwater for beneficial uses such as drinking water, recreation, and agricultural production. The Paso Robles Groundwater Basin (PRGWB) is one of several identified distinct sub-basins within the Upper Salinas River Basin and encompasses an area of approximately 505,000 acres. The PRGWB extends from San Ardo in Monterey County to the Garden Farms areas south of Atascadero, and from the Highway 101 corridor east to Shandon. The PRGWB includes the Atascadero sub-basin which has not shown the same significant levels of decline in recent years. The sub-basin is bordered by unique geologic features that create a defined separation from the majority of the main basin. In addition, this sub-basin is largely managed and controlled by the Atascadero Mutual Water Company. Based on these factors, the Atascadero sub-basin is considered a unique and separate entity. When referring to the PRGWB throughout this document, it is assumed not to include the Atascadero sub-basin unless otherwise stated.

1.2 Historical Background

According to multiple studies of the PRGWB, annual basin pumping is now at or near the basin's perennial yield (Paso Robles Groundwater Management Plan, 2011). From 1997–2009, water levels declined on average of 2–6 feet per year, depending on the location. A Todd Engineering monitoring report (2007) indicated that the Basin was not approaching the safe yield level but some areas were experiencing significant declines in groundwater elevations. A later study completed in 2009 suggested groundwater pumping was approaching the safe yield level of the Basin (citation). The 2010 Resource Capacity Study prepared by the SLO County Planning Department stated that the Basin is now near or at perennial yield levels. In October

2012 the SLO County Board of Supervisors (Board of Supervisors) certified a Level of Severity III, indicating the Paso Basin has reached its threshold of safe perennial yield, excepting out the Atascadero Sub-basin, due to declining water levels. In August 2013, the Board of Supervisors adopted an urgency ordinance to limit new groundwater pumping from the PRGWB. As stated in the urgency ordinance, rural and agricultural land owners must have an approved "offset" (1:1 replacement water) in order to pump additional groundwater. The basin supplies water for 29% of SLO County's population and an estimated 40% of the agricultural production of the County (PRGWB Blue Ribbon Committee 2013). The issuance of Ordinance Number 3246 essentially established a, "moratorium on new or expanded irrigated crop production, conversion of dry farm or grazing land to new or expanded irrigated crop production and new development dependent upon a well in the PRGWB unless such uses offset their total projected water use[1]".

In order to comply with the provisions of the urgency ordinance, the Board of Supervisors initiated the development of a water offset program that would provide a framework for new development of rural residential and agricultural properties under the premise that new water demands would be offset using water savings to limit increased drawdown of the stressed basin. The County contracted with the Upper Salinas-Las Tablas RCD to provide a program framework for new and expanded irrigated agricultural uses that overlie the basin and for non-exempt rural residential irrigated landscaping (rural lot exemptions are outlined in section 1.3.1).

The Upper Salinas-Las Tablas Resource Conservation District (RCD) collaborated with experts in fields such as hydrogeology, hydrologic engineering, and Geographic Information System (GIS) to evaluate historic water use within the basin and to develop this framework to offset new applications for agricultural and rural residential water use. Additionally, representatives from the University of California Cooperative Extension (UCCE), County Planning Department, Natural Resource Conservation Service (NRCS), and members of the agricultural community served an advisory role and provided additional technical expertise. The goal of the project team was to develop a framework for agricultural and rural water users to balance, or offset, future water demands with water savings (credits).

The Offset Program relies on the best available existing public data in an attempt to encompass the myriad of application types and potential future water use demands. Additionally, the Offset Program was designed to quantify and track new irrigated agriculture within the PRGWB through the use of GIS and an existing database reliant upon groundwater well, parcel, and water use information to provide opportunities for evaluation and verification of the program goals.

1.3 OFFSET PROGRAM DRAFT

The following section outlines the steps taken to develop the Ag Water Offset Program as well as describes the program itself. For ease of reading, supporting documentation such as tables and calculations can be found in the appendices.

1.3.1 Types of Projects & Objectives

[1] Water users who were not already vested in groundwater use prior to August 27, 2013

The goal and objective of the Water Offset Program is to provide a framework for processing 1:1 irrigated water offset projects. As with any program, there are limitations to the type and scope of projects that will meet program goals and objectives. Future development and possible refinement of the program may be required based on monitoring and evaluation of the PRGWB and the Water Offset Program (potential resiliency). The following are the types of projects considered for application to the Offset Program:

- Irrigated agricultural crop conversions resulting in increased water use (e.g., vineyard to almonds);
- New irrigated agricultural development on previously un-irrigated land; and
- Rural groundwater uses that are not included in the County's urban domestic offset program (maximum permitted irrigated landscape area of 1,000 square feet landscape of immediate exterior, assuming 10% turf, and using a total of 300 gallons per dwelling unit per day of irrigation water).

1.3.2 Offset Intake Process

In order for the Water Offset Program to be reputable, transparent, and usable, applications for water offset are intuitive, standardized, and informative. An Offset Intake Form was developed to process applications and to establish a baseline to monitor the Offset Program. The information to be included, but not limited to, in the Offset Intake Form will include the location of the offset and credit, property owner, groundwater well location(s), crop type, amount (annual average acre-feet [AF]), and type (*i.e.* category 1, 2, 3, and 4, explained later). Documentation, such as landowner contracts/agreements, monitoring reports and production reports may be included as part of the application process to track and monitor groundwater transactions in the PRGWB.

Offset programs have been developed in other areas and for other purposes. Most relate to financial transactions between countries, agencies, private companies and/or the public. Although these programs are of interest, the SLO County PRGWB Water Offset Program modeled the Offset Intake Form after other natural resource offset programs such as the carbon offset program by the Nature Conservancy. Although carbon and water are not unilateral in source and use, the goals of each program (*i.e.* neutrality) is synonymous. Therefore, the Water Offset Program modeled attributes of the carbon offset program in an effort to transfer and track credits to water offsets.

1.3.3 Program Development

In order to develop the program, a standard for water use by crop type was developed using published crop water requirement values. All crops were categorized into seven (7) main categories of crops. These categories include alfalfa, pasture, citrus, nursery, deciduous, vegetables, and vineyards. Data was reviewed, along with published articles, to determine suitable water duty tables (see Section 2: Crop Water Requirement). A value for water use by crop type was calculated and applied to each crop category. The analysis further evaluated annual acre-feet (AFY) of water use in each Water Planning Area (WPA) within the PRGWB to assess if an offset program was feasible. Based on the types of projects to be considered from above, an offset program was determined to be feasible if standards for water use were adopted, rather than relying on individual water use information provided by landowners. Established standards for crop water use are necessary because of the number of variables that are involved such as soils, evapotransporation rates, water year types, geographic variability, etc. that would increase the complexity of the program to the extent it is unworkable and require a great deal of specialty expertise to manage.

Following determination of water use by crop type, the next step in the development of the program was to develop proximity criteria for acceptable offset credits that ensure that the offset credit does not cause unintended impacts to neighboring wells and the groundwater basin from applying offsets (see Section 3: Impact Proximity Analysis). Again, as with the water use by crop type, a categorical (category 1-4) process was established to develop the proximity criteria. Each category is progressively more complex and the proximity criteria more stringent depending upon the location of the credit. Because credits and offsets will not always be on the same property or by the same landowner, a mechanism to calculate impacts within the PRGWB was developed. This mechanism uses standard drawdown calculations to assess the sphere of influence from well operations. This is an important step to be able to verify and ensure offset credits actually mitigate increased groundwater use within the PRGWB.

As mentioned previously, to process the offset program requests, an application form was created. The form was modeled after carbon offset programs because of its similarity to other natural resource offsets. As such, an applicant under the Water Offset Program will present a proposal for offsetting the water use with appropriate credits. The proposal must demonstrate the credit consists of physical water[2] and the quantity of the credit must be at least equal to the quantity of the new water use in acre-feet (AF) subject to the ratio requirements set forth by the approved program. Additional considerations for offset applications are:

- Applicant(s) must define annual volume of new water use and source of credit using verified meter data, crop water use tables, and/or historical water use data. Historical data includes a combination of aerial photography showing location of use, irrigation device flow computations, and theoretical pump discharge and power records. Crop water use tables will be used by the County and/or the RCD to evaluate the application;
- If there are credits remaining that cannot be applied to the new water use, the County or the RCD will not track or account for them (tracking will occur in deed documentation);
- The application must meet proximity criteria (see proximity criteria in Section C: Impact Proximity Analysis);
- The credit and new water use must be verifiable;
- Metering of new water use, and the use that is the source of the offset credit will be required;
- Documentation must be provided annually that the source of the offset has been maintained;
- Special consideration will be given to establishing offset credits within areas most severely impacted by over-pumping (e.g., Estrella) and redistributing this pumping to other areas where there is less severity;

[2] Physical water equates to actual water that has been applied for beneficial use within the past five years.

- The owner of the new irrigated development must have a written agreement with the landowner providing the offset credit that will remain in effect for the duration of the new water use; and
- A covenant will be required to be recorded on the deeds for the land being used to supply the credit and the land using the credit for the expanded groundwater use.

1.3.4 Possible Sources of Offset Credits

Credits for the Water Offset Program, within the PRGWB, may come from a combination of sources. As technology, information, practices, and irrigation efficiencies evolve and improve, other forms and sources of credits may become available to offset new water use in the PRGWB. Below is a list of potential sources of credits available from current documented practices.

- Fallowing of irrigated land resulting in less pumping;
- Conservation and improved efficiency resulting in less pumping (e.g., install high efficiency irrigation technology for perennial crops; flow meter must be installed to verify reduction of water usage);
- Reduced irrigation (deficit irrigation at less than agronomic rates, flow meter to verify); and
- Crop conversion(s) to less water intensive crops as designated by the adopted program water use charts (e.g. alfalfa to dryland range).

1.4 Program Establishment and Monitoring Protocol

[Insert language regarding Program Establishment and Monitoring Protocol Creation]

1.5 Education and Outreach (generally described)

Preliminary Outreach:

- Peer Review of Draft Program Language (May/June 2014)
- Host Ag Focus Group(s) to develop Case Studies/Live Scenarios (June 2014)
- Road Show: Present to Key Agricultural Associations/Stakeholders (e.g. Wine Alliance, Farm Bureau, etc) (June, July 2014)

Mainstream Outreach

- Public at large & Town Hall Sessions (August/Sept 2014)

SECTION 2. CROP WATER REQUIREMENTS

2.1 Crop Water Use

This section presents the equations and values used to calculate the Crop Water Requirement values that will be used to establish offset credits in the program. This work is also presented in the SLO Master Water Report (2012). Only data for Santa Margarita, Atascadero/Templeton, and Salinas/Estrella Water Planning Areas (WPA) presented in the Master Water Report apply to the Paso Basin and are summarized and presented here.

2.1 Water Planning Areas

Several factors in the calculation of crop water requirement vary by Water Planning Area (WPA). San Luis Obispo County is divided into 16 WPAs (SLO 2012). Most of the PRGWB area is in the Salinas/Estrella WPA. Only the data for Santa Margarita, Atascadero/Templeton, and Salinas/Estrella WPAs were summarized and are presented in the Appendix.

2.2 Crop Water Requirements

In order to determine how much water might be saved by switching from one crop to another, the amount of water required to grow particular crops must be determined. Several variables are required for this calculation of annual crop-specific applied water, calculated as acre-feet water per acre per year. These include factors related to the crop, the location in which it is grown, irrigation water quality, and irrigation system efficiency. It is important to note crop water use is influenced by the variability in weather parameters, crop characteristics, management practices, and other environmental factors (Allen et al. 1998). As a result, a precise number for Crop Water Requirement is difficult to determine. The Master Water Report includes a range of crop water requirements presented as low, medium, and high values to account for this variability. We recommend that a medium value be used in the offset program for each crop category because this represents an average condition. Using the low value could result in insufficient water being allocated for the crop and a high value could result in too much water use in some years. Equations and values used to calculate the Crop Water Requirements in the SLO Master Water Report (2012) are given in Appendix I.

The annual crop-specific applied water expressed in acre-feet per acre per year (AF/Ac/Yr) is calculated in the SLO Waster Water Report using the following equation:

$$\text{Annual Crop-Specific Applied Water(AF/Ac/Yr)} = \frac{\text{ETc - ER}}{(1 - \text{LR})x\ \text{IE}} + \text{FP}$$

where:
ETc = crop evapotranspiration = ETo x Kc

ETo = reference evapotranspiration
Kc = crop coefficient
ER = effective rainfall
FP = frost protection
LR = leaching requirement
IE = irrigation efficiency

Each variable used in the equation is discussed in the following sections.

2.1.1 Evapotranspiration and Crop Groups

Evapotranspiration is the combination of the water lost from a cropped area by evaporation from wet soil and plant surfaces, and loss of water from plant transpiration. The Food and Agriculture Organization of the United Nations (FAO) presents a procedure for estimating crop evapotranspiration in Irrigation and Drainage Paper No. 56 (Allen et al. 1998). The California Department of Water Resources, University of California Cooperative Extension, and the Cal Poly Irrigation Training and Research Center use this procedure, and it is the same procedure used in the preparation of the San Luis Obispo (SLO) Master Water Report (2012). Crop evapotranspiration (ETc) is calculated as the product of reference evapotranspiration (ETo) and a crop specific coefficient (Kc). Crops are assigned to Crop Groups on the basis of water demand for evapotranspiration.

2.1.2 Reference Evapotranspiration (ETo)

Reference evapotranspiration represents the approximate theoretical water use of a well watered, cool-seasoned grass, 4 – 6 inches tall, under full cover. The principal weather parameters affecting evapotranspiration are radiation, air temperature, humidity, and wind speed. The California Irrigation Management Information System (CIMIS) is a program of the Office of Water Use Efficiency, California Department of Water Resources (DWR) that manages a network of over 120 automated weather stations in the state of California. Hourly average weather data is used to calculate hourly ETo. The 24 hourly ETo values for the day (midnight-to-midnight) are then summed to produce estimates of daily ETo. Water Planning Areas were grouped into climate groups (Table A8) and ETo values from appropriate CIMIS were selected for the climate groups (Table A9). Reference evapotranspiration can be quite variable (Figure 1). It is higher during the summer months and varies between years depending on whether the year was wet, normal, or dry.

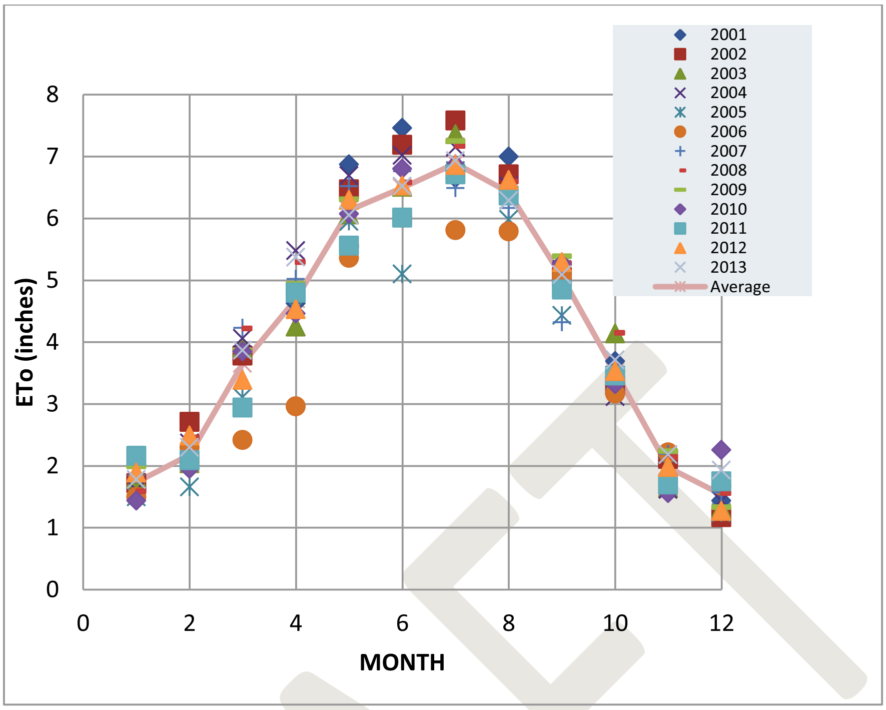


Figure 1. Monthly variation in the Reference Evapotranspiration (ETo) at CIMIS Station 163 in Atascadero (2001-2010)

2.1.3 Crop Coefficient (Kc)

The crop coefficient integrates the effects of characteristics that distinguish a field crop from the grass reference described above. Different crops will have different Kc coefficients. The changing characteristics of the crop over the growing season also affect the Kc coefficient. In general, the Kc value increases as the plants grow in size. These Kc values were adapted from a Department of Water Resources Bulletin (DWR 1974) and two UC Cooperative Extension documents (Snyder et al. 1989a, b).

A specific crop in SLO County is assigned the Kc value used for the Crop Group in which it categorized (Table A10). Assignment of Crop Groups is discussed below.

Table 1. Crop Group and Commodities Used for the Agricultural Demand Analysis

Crop Group	Primary Commodities
Alfalfa	Alfalfa
Nursery	Christmas trees, miscellaneous nursery plants, flowers

Pasture	Miscellaneous grasses, mixed pastures, sod/turf, sudangrass
Citrus	Avocados, grapefruits, lemons, oranges, olives, kiwis, pomegranates (non deciduous)
Deciduous	Apples, apricots, berries, peaches, nectarines, plums, figs, pistachios, persimmons, pears, quinces, strawberries
Vegetables	Artichokes, beans, miscellaneous vegetables, mushrooms, onions, peas, peppers, tomatoes
Vineyard	Wine grapes, table grapes

2.1.4 Crop Evapotranspiration (ETc)

Crop evapotranspiration is calculated by multiplying the reference evapotranspiration (ETo) (Table A9) by the crop coefficient (Kc) (Table A10). The results are summarized in Table A11. Vineyard and vegetable crops have the lowest ETc values. Pasture and alfalfa have the highest ETc values, twice the ETc of vineyards.

2.1.5 Crop Groups

Crops with similar calculated ETo values are assigned to Crop Groups by California DWR. Although the groups are based on commodities that may have similar water requirements, the actual water usage will vary based on individual commodity, stage of maturity, presence of cover crop, soil type, and management factors. A significant discrepancy in the grouping is that water use by strawberries is more similar to water use by vegetables than by deciduous trees.

2.1.6 Effective Rainfall

Effective rainfall is defined as the part of the rainfall that is used to meet the evapotranspiration needs of growing crops, and does not include runoff and percolation below the root zone (NEH, 1993). The primary factors that influence effective rainfall are precipitation characteristics, soil properties, crop ETc, and irrigation management.
The amount of effective rainfall was calculated by multiplying the average precipitation measured at the rainfall station assigned to the WPA in which a crop is grown (Table A2) by the effective rainfall percentage, that is, the portion of rainfall that infiltrates into the soil (Table A3). Recharge of soil water by rainfall during winter can reduce the crop irrigation requirement (NEH 1993). However, the contribution of winter rain events is difficult to estimate. In semi-arid regions, the winter precipitation may be inadequate to recharge the crop root zone before the start of irrigation. However, a Paso Robles vineyard irrigation study showed a reduction in irrigation application with greater rainfall during the preceding winter (Battany 2013).

2.1.7 Frost Protection

Only grapes and berries are protected from frost during the winter months (Table A4). Sprinkler frost protection is used for grapes throughout SLO County from March to April, and for strawberries and blueberries in Salinas/Estrella WPA from January to March. The amounts of water used for frost protection included in the calculation of the Annual Crop-Specific Applied Water for vineyards and berries were 0.25 AF/Ac/Yr and 0.4 AF/Ac/Yr (SLO 2012). It should be noted that the amount of water used for frost protection varied between farms and years. The SLO Master Water Report describes the assumptions made to calculate the amount of frost protection water used for grapes and berries.

2.2.1 Leaching Requirement

Leaching requirement is the fraction of the applied water required to maintain a desired salinity level in the soil. Leaching requirements in Table A5 are adapted from the Final Report Paso Robles Groundwater Basin Study (2002).

2.2.2 Irrigation Efficiency

The SLO Master Water Report relies on information from local farm advisors to identify common types of irrigation used for the various crops (Table A6). The most common irrigation systems used in this area are sprinkler and micro-irrigation (aka drip). Alfalfa and pastures are irrigated using sprinklers only, and vineyards use only drip irrigation.
Irrigation Efficiency was estimated using the following equation:

$$\text{IE (\%)} = \text{Distribution Uniformity} \times (1\text{- Losses}) \times 100$$

Distribution uniformity (DU) is defined as a measure of how uniformly water is applied to different areas in a field, expressed as a percentage. Average Distribution Uniformity values for sprinklers and micro irrigation systems of 75 and 85 percent were used to calculate the irrigation efficiency (IE).Water loss from the system occurs through over-watering, evaporation from the wet soil surface, runoff, and seepage from water distribution ditches, and leaks. Data on irrigation uniformity and losses was obtained from local Resource Conservation Districts, vineyard owners, and recent studies reviewed by ESA during the preparation of the Master Water Report (SLO 2012). Irrigation Efficiencies were assigned to crop groups according to the primary irrigation system (Table A7). A considerable range in IEs can be expected between individual system DUs and water loss control.

2.3 Water available from crop conversion

Calculating the amount of water that is made available by switching from a specific crop to one requiring less water can be done by using the annual crop-specific applied water calculated for each Crop Group within each WPA (SLO 2012). The calculations for applied water are further divided into a range of high, medium, and low (Table A13). It is important to note that exact numbers presented in Table A13 cannot be reproduced because the tables only show rounded numbers for average precipitation (Table A2), reference evapotranspiration (Table A9), and crop evapotranspiration (A11). An example of this information for the Salinas/Estrella WPA, using the "medium" range value, is shown in Table 2.

Table 2. Existing Crop-Specific Applied Water (AF/Ac/Yr) by Crop for the Salinas/Estrella WPA

Crop Group	Applied Water (AF/Ac/Yr)
Alfalfa	4.5
Citrus	2.3
Deciduous	4.0
Nursery	2.5
Pasture	6.0
Vegetables	1.9
Vineyard	1.7

To determine how many acres of a "new" crop can be grown using the same amount of water as an "existing" crop, an area conversion factor can be calculated by dividing the "existing" crop applied water by the "new" crop applied water. Converting from a high water usage crop to one requiring less water will result in a larger (*i.e.* more than 1) acreage conversion factor. An example of the results of this calculation crops in the Salinas/Estrella WPA is shown in Table 3. In this WPA, because alfalfa and pasture use more water than vineyards or vegetables, the area conversion factor ranges between 2.4 to 3.5. Likewise, if 100 acres of irrigated alfalfa in this WPA was fallowed, the water could be used for 265 acres of "new" vineyards. It is clear that there is water available for crop conversion within the Salinas/Estrella WPA.

Table 3. Crop Area Conversion per Crop for Salinas/Estrella WPA

Convert from 1 Acre	Applied Water (AF/Ac/Yr)	**To Acreage of**						
		Alfalfa	Citrus	Deciduous	Nursery	Pasture	Vegetables	Vineyard
Alfalfa	4.5		1.96	1.13	1.80	0.75	2.37	2.65
Citrus	2.3	0.51		0.58	0.92	0.38	1.21	1.35
Deciduous	4.0	0.89	1.74		1.60	0.67	2.11	2.35
Nursery	2.5	0.56	1.09	0.63		0.42	1.32	1.47
Pasture	6.0	1.33	2.61	1.50	2.40		3.16	3.53
Vegetables	1.9	0.42	0.83	0.48	0.76	0.32		1.12

Vineyard	1.7	0.38	0.74	0.43	0.68	0.28	0.89	

2.4 Existing water usage by crop type in the PRGWB

The SLO Water Master Report presents the existing acreage of irrigated crops as reported by the growers as August 2008 (Table A12). For the calculations here we used the latest (2013) irrigated crop acreage from County Agriculture Commissioners Office, 2013 crop layer, for the sub-basins in the PRGWB (Table 4).

Table 4. Existing Irrigated Crop Acreage by Sub-Basin

	Crop Group 2013						
Sub Basin	**Alfalfa**	**Citrus**	**Deciduous**	**Nursery**	**Pasture**	**Vegetables**	**Vineyard**
Estrella	635.2	132.2	569.9	9.4	740.1	3608.2	17032.2
Creston	462	247	82.2	11.7	168.5	2039.1	6984.1
Shandon	293.5	18	0	43.8	9.2	1227.2	3727.7
Atascadero	57.3	6.8	12.9	12	236	1777.1	396.8
San Juan	388.9	0	0	0	200.9	710.4	2671.6
South Gabilan	0	1.3	0	0	0	90.6	464.7
North Gabilan*	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bradley*	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total	**1836.9**	**405.3**	**665.0**	**76.9**	**1354.7**	**9452.6**	**31277.1**

* Excluded from analysis and not within San Luis Obispo County limits.

The estimated total volume of water use by each crop type in all the sub-basins was calculated by multiplying the total irrigated crop area (Table 4) by the medium range Crop Applied Water values for crops in the Salinas/Estrella WPA (Table A13).

Information on how much water can be converted from one crop to another within the PRGWB is shown in Table 5. This table indicates that a maximum of 16,394 AF/Yr will be available for the offset program or a maximum of 9,644 Ac of new vineyards.

Table 5. Estimated Total Irrigation Water Use per Year (AF/Yr) by Crop within all the Sub-Basins

Crop Group	Applied Water (AF/Ac/Yr)	Total Acres	Total Irrigation Water Use per Year (AF/Yr)
Alfalfa	4.5	1836.9	8,266
Citrus	2.3	405.3	932

Deciduous	4.0	665.0	2,660
Nursery	2.5	76.9	192
Pasture	6.0	1354.7	8,128
Vegetables	1.9	9452.6	17,960
Vineyard	1.7	31277.1	53,171
		Total	**91,310**

SECTION 3. IMPACT PROXIMITY ANALYSIS

3.1 PROXIMITY CRITERIA

To encompass the various possibilities of offsets, a series of categories or types of credits were established; the first category will be the simplest condition and subsequent categories will be more involved. Proximity criteria that must be met for each Category of offset are described below.

Category 1 – Offset Credit and Increased Water Use on Same Property from Same Well

Category 1 applies when the offset credit is derived from the same property, same well, and same ownership. If the proposed new water use (well) is within the areas determined by San Luis Obispo County as being severely depleted, no offset credits will be allowed that will permit additional pumping in that area unless the offset credit is derived from the same depleted area. Figure 1 is a map prepared by GEI Consultants (August 2013) that shows the most recent Paso Robles Basin groundwater depletion map for the period 1997 - 2013. On this map, the areas with severe depletion are shown in deep red. For the purposes of this analysis, the RCD is recommending that the severe depletion area be defined as the area where there has been greater than 50 feet of groundwater level decline. No additional pumping will be permitted in this area if the offset credit is derived from an area outside of the severe depletion area. Credits that are derived from within the severe depletion area can be applied to new uses within the severe depletion area. It is recommended that the severe depletion map be updated annually using updated water level data and that the map be prepared using consistent data interpolation protocols. Category 1 offset credit proposals located outside of the severely depleted area have no further proximity related criteria that must be met.

Category 2 – Offset Credit Coming from Different Well on Adjacent Property (same owner)

Category 2 applies when the offset credit is derived from a different well on the same property with the same ownership. The applicant must meet the Category 1 criteria and the offset credit source must be derived from a well that is open to the same hydrogeological strata as the well providing the new water source (must provide well log/report indicating strata type and other geologic information).

The applicant must demonstrate that neighboring wells (irrigation and domestic) located near the well serving the new water use will not be significantly impacted by the additional water level drawdown, or all property owners within that radius provide written approval of the new water use. The method for determining the amount of drawdown impact at neighboring wells is presented in Appendix B. Once the level of drawdown in the neighboring well has been calculated, the next step in the process is to evaluate the significance of the water level drawdown impact on neighboring wells. For the purposes of this analysis, water level drawdown in the neighboring well means the difference between the static water level when the well is not being operated for at least 4 hours and the water level in the neighboring well when the well serving the new use is being operated. In order to evaluate the level of impact, criteria were established. For this analysis, a significant impact on a neighboring well is defined as follows:

a) For domestic wells, the calculated water level drawdown at the impacted well is greater than 15 feet or more than 20 percent of the available drawdown in the well (available drawdown is defined as the amount of standing water above the pump intake or well screen), or
b) For irrigation wells, the calculated water level drawdown at the impacted well is greater than 30 feet or more than 20 percent of the available drawdown in the well, or
c) The drawdown would result in the water level in the impacted well to drop below the pump intake or well screen.

If the calculated water level drawdown exceeds the drawdown criteria, the applicant will be required to notify the affected neighboring well owner(s) in order to determine where the top of screen and pump intake is set in the neighboring well(s). If the neighboring well owners do not respond and provide the requested information within 10 business days of being contacted, the applicant may not be required to address the drawdown impact. Alternatively, the applicant may revise the application to reduce the impact below the level of significance or provide evidence that there is a written agreement with the neighboring well owner to mitigate the impact.

Category 3 **– Offset Credit Derived from a Different Well Located on Adjacent Properties Owned by a Different Property Owner**

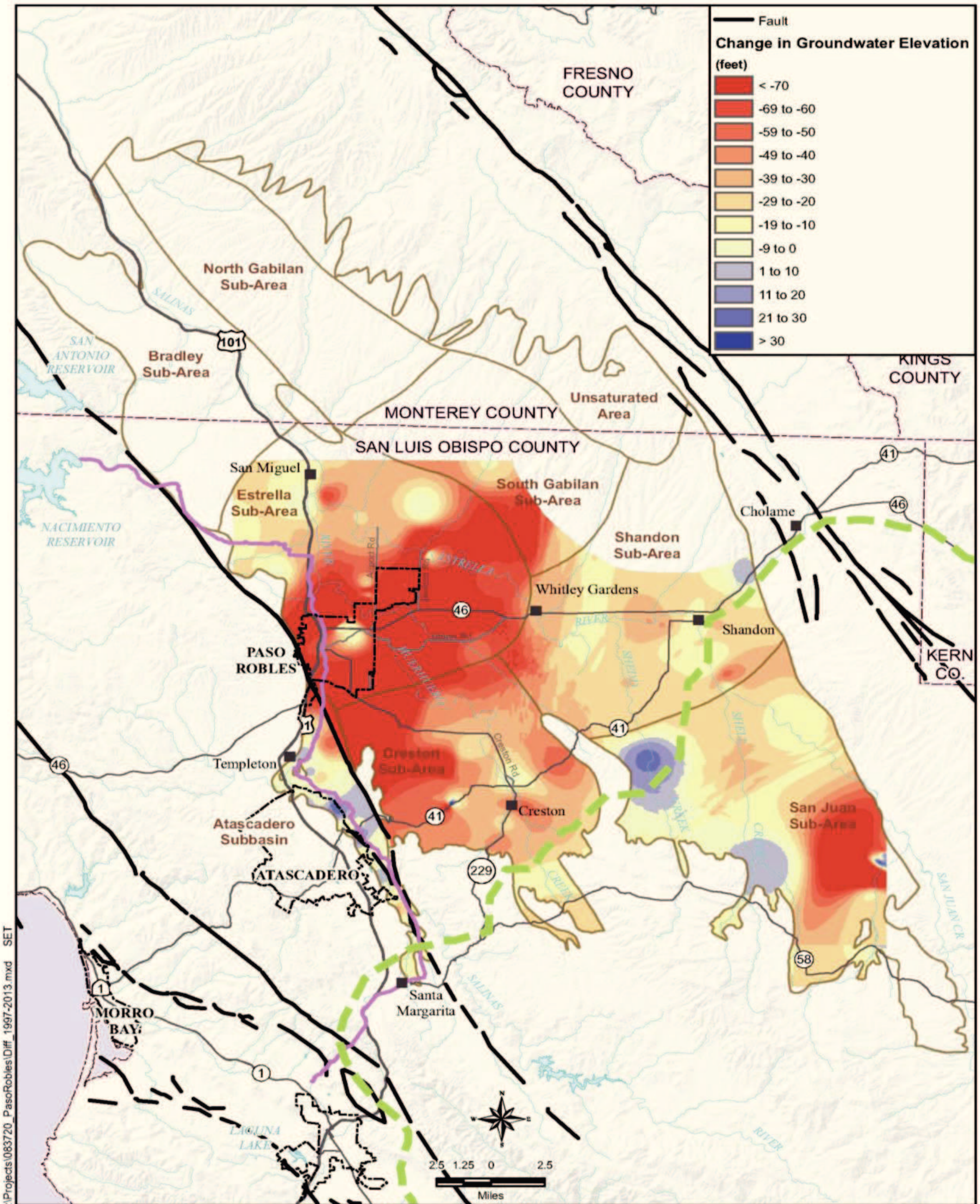
Category 3 applies when the credit is derived from a different well located on adjacent properties, involving another property owner. The applicant must meet the proximity criteria for Category 1 and Category 2 offsets and must have a written agreement with the landowner providing the credit that will remain in effect for the duration of the new water use. Depending on the circumstance and permanency of the new use, the County may require a covenant be recorded on the deeds for the land being used to supply the offset credit and the land that is using the offset credit for the expanded groundwater use.

Category 4 **– Offset Credit from a Non-Adjacent Property (may or may not be the same land owner)**

Category 4 applies in cases where the offset credit is coming from a property that is not adjacent (may or may not be the same land owner). The applicant must meet the proximity criteria for Category 1, 2, and 3 offsets and the proposed offset location (e.g., well) must be within the cone of depression formed by the well serving the new use. This approach was developed based on established hydrogeologic principals with an assumption that an offset credit can be a created by reduced pumping. If the resulting water level recovery at the credit well location falls within the cone of depression of the pumping well serving the new use, the proposed offset credit is assumed to benefit the aquifer and offset the new use. Because the cone of depression caused by pumping in a confined aquifer (such as the Paso Robles Formation) can theoretically extend outward in a radial pattern for miles, it is necessary to pick a threshold value for water level drawdown, at some distance away from the well serving the new use, that is assumed to be significant and measureable. In this case, a water level drawdown value of 2 feet is assumed as a threshold. The area that falls within this radial distance from the pumping well is assumed to be in hydraulic connection with the pumping well as long as the water bearing strata are connected and a groundwater flow boundary such as a fault or fold does not interrupt this connection. For the purposes of this analysis, we have assumed that the aquifer is homogeneous and laterally extensive (which we know is not always the case). Other drawdown values could be selected as a threshold; however, this assumed value is believed to be protective of the aquifer, while providing for reasonable opportunities to apply an offset. This approach improves the likelihood that the proposed offset credit benefits the aquifer within the radius of impact from the well serving the new use.

The methodology used for computing the radial distance away from the well serving the new use where a Category 4 offset may be applied is presented in Appendix C. It is based on the same Theis non-equilibrium equation described previously for the evaluation of drawdown impacts on neighboring wells and the estimated aquifer parameters for each sub area presented in Table 1.

ATTACHMENT F



Paso Robles Groundwater Basin In San Luis Obispo County	GEI Consultants	GENERALIZED DIFFERENCE IN SPRING GROUND-WATER ELEVATIONS BETWEEN 1997 - 2013
San Luis Obispo County, California		AUGUST 2013 FIGURE 1

Annual Crop-specific Applied Water

The annual crop-specific applied water expressed in acre-feet per acre per year (AF/Ac/Yr) is calculated in the SLO Waster Water Report using the following equation:

$$\text{Annual Crop-Specific Applied Water(AF/Ac/Yr)} = \frac{\text{ETc - ER}}{(1 - \text{LR})x\ \text{IE}} + \text{FP}$$

where:
ETc = crop evapotranspiration = ETo x Kc
ETo = reference evapotranspiration
Kc = crop coefficient
ER = effective rainfall
FP = frost protection
LR = leaching requirement
IE = irrigation efficiency

Each component of the equation and its values will be discussed in the following sections.

Steps to Determine Crop Specific Applied Water

1) Determine your Crop Group (Table A1)
2) Determine the contribution from the Effective Rainfall (Tables A2 and A3)
3) Select the contribution from frost protection: Vineyards=0.25 AF/Ac/Yr; Berries = 0.4 AF/Ac/Yr (Table A4)
4) Determine the contribution from leaching requirement (Table A5)
5) Select the irrigation efficiency of your system: sprinkler = 0.75; micro irrigation = 0.85
6) Select your climate group (Table A8)
7) Select the ETo (Table A9) and Kc values (Table A10)
8) Calculate the monthly ETc (ETo x Kc) and calculate annual ETc (i.e. sum all the monthly values)
9) Convert the ETc inches/yr to AF/Ac/Yr by dividing by 12 (Table A11)
10) Calculate the Crop-Specific Applied Water (AF/Ac/Yr) for your site

Table A1. Crop Group and Commodities Used for the Agricultural Demand Analysis

Crop Group	Primary Commodities
Alfalfa	Alfalfa
Nursery	Christmas trees, miscellaneous nursery plants, flowers
Pasture	Miscellaneous grasses, mixed pastures, sod/turf, sudangrass
Citrus	Avocados, grapefruits, lemons, oranges, olives, kiwis, pomegranates (nondeciduous)
Deciduous	Apples, apricots, berries, peaches, nectarines, plums, figs, pistachios, persimmons, pears, quinces, strawberries
Vegetables	Artichokes, beans, miscellaneous vegetables, mushrooms, onions, peas, peppers, tomatoes
Vineyard	Wine grapes, table grapes

Table A2. Rainfall Stations and Average Precipitation (Inches/Yr) by Water Planning Area (for comparison purposes only)

Water Planning Area	Assigned Rainfall Station	County Gage #	Average Precipitation (AF/Ac/Yr)	Record
Santa Margarita	Santa Margarita	9a	2.03	1887-2003
Atascadero/Templeton	Atascadero Mutual Water Company	34	1.45	1916-2003
Salinas/Estrella	Paso Robles	10	1.27	1972-2003

Table A3. Effective Rainfall Percentage for Each Crop Group

Crop	Low Range	High Range
Alfalfa	40%	60%
Citrus	40%	60%
Deciduous	40%	60%
Nursery	30%	50%
Pasture	40%	60%
Vegetables	15%	25%
Vineyard	30%	50%

Table A4. Estimated Frost Protection Requirements in AF/Ac/Yr

Crop Type	Estimated AF/Ac/Yr for frost protection
Berries	0.4
Grapes	0.25

Table A5. Leaching Requirements for the Three WPAs

Crop	Leaching Requirement
Alfalfa	0.08
Citrus	0.05
Deciduous	0.08
Nursery	0.05
Pasture	0.11
Vegetables	0.08
Vineyard	0.16

Table A6. Estimates of Current Irrigation System Types by Crop Group

Crop	Percentage of Acreage with Irrigation System Type (%)		
	Surface	Sprinkler	Micro
Alfalfa	0	100	0
Citrus (permanent)	0	20	80
Deciduous	0	20	80
Nursery	0	50	50
Pasture	0	100	0
Permanent	0	20	80
Vegetables	0	40	60
Vineyard	0	0	100

Table A7. Irrigation Efficiencies for Each Crop Group

Crop	Existing Irrigation Efficiency Ranges (%)	
	Low	High
Alfalfa	60%	75%
Nursery	60%	75%
Pasture	60%	75%
Citrus and Deciduous	70%	85%
Vegetables	70%	85%
Vineyard	70%	85%

Table A8. Assigned Climate Groups for WPAs

Water Planning Area	Assigned Climate Group
Santa Margarita	Atascadero
Atascadero/Templeton	Atascadero
Salinas/Estrella	Paso Robles

Table A9. Monthly Reference Crop ETo (Inches/Month) by Climate Group

Month	ETo (inches/month)	
	Atascadero	Paso Robles
January	1.2	1.6
February	1.5	2.0
March	2.8	3.2
April	3.9	4.3
May	4.5	5.5
June	6.0	6.3
July	6.7	7.3
August	6.2	6.7
September	5.0	5.1
October	3.2	3.7
November	1.7	2.1
December	1.0	1.4
Total (Inches/Yr)	43.7	49.2

Table A10. Crop Coefficient for Each Crop Group by Month

Month	Crop Coefficient						
	Alfalfa	Citrus	Deciduous	Nursery	Pasture	Vegetables	Vineyard
January	0.0	0.56	0.0	0.5	0.0	0.0	0.0
February	0.0	0.56	0.0	0.5	0.0	0.0	0.0
March	0.9	0.56	0.6	0.5	1.0	0.0	0.0
April	0.9	0.56	0.7	0.5	1.0	0.0	0.0
May	0.9	0.56	0.8	0.5	1.0	0.0	0.6
June	0.9	0.56	0.9	0.5	1.0	0.0	0.7
July	1.0	0.56	1.0	0.5	1.0	0.0	0.6
August	1.0	0.56	1.0	0.5	1.0	1.0	0.5
September	1.1	0.56	0.9	0.5	1.0	1.0	0.3
October	1.0	0.56	0.8	0.5	1.0	1.0	0.1
November	0.0	0.56	0.0	0.5	0.0	1.0	0.0
December	0.0	0.56	0.0	0.5	0.0	1.0	0.0

Table A11. Annual Crop Evapotranspiration (AF/Ac/Yr) for each Crop Group and Water Planning Area

Crop	Annual Crop Evapotranspiration (AF/Ac/Yr)		
	Santa Rita WPA	Atascadero/Templeton WPA	Salinas/Estrella WPA
Alfalfa	3.1	3.1	3.4
Citrus	2.0	2.0	2.3
Deciduous	2.8	2.8	3.0
Nursery	1.8	1.8	2.1
Pasture	3.2	3.2	3.5
Vegetables	1.4	1.4	1.6
Vineyard	1.3	1.3	1.4

Irrigated Crop Acreages in PRGWB WPAs

SLO Water Master Report, Agriculture/Crop ArcGIS® layer for the County from August 2008.

Table A12. Existing Irrigated Crop Acreage by Water Planning Area

Crop	Irrigated Crop Acreage		
	Santa Rita	Atascadero/Templeton	Salinas/Estrella
Alfalfa	15	0	800
Citrus	0	32	319
Deciduous	7	712	655
Nursery	0	80	76
Pasture	55	589	1,446
Vegetables	0	17	2,098
Vineyard	974	3,434	27,424
Total	**1,051**	**4,864**	**32,818**

Crop-Specific Applied Water

Table A13. Crop-Specific Applied Water (AF/Ac/Yr) by Crop and Water Planning Area

Crop	Ranges	Applied Water (AF/Ac/Yr)		
		Santa Rita WPA	Atascadero/ Templeton WPA	Salinas/ Estrella WPA
Alfalfa	Low	3.2	3.2	3.8
	Medium	3.9	3.9	4.5
	High	4.5	4.5	5.2
Citrus	Low	1.4	1.4	1.9
	Medium	1.8	1.8	2.3
	High	2.2	2.2	2.7
Deciduous	Low	2.5	2.5	3.4
	Medium	3.0	3.0	4.0
	High	3.5	3.5	4.5
Nursery	Low	1.5	1.5	2.0
	Medium	2.0	2.0	2.5
	High	2.4	2.4	2.9
Pasture	Low	4.8	4.8	5.2
	Medium	5.7	5.7	6.0
	High	6.5	6.5	6.8
Vegetables	Low	1.4	1.4	1.6
	Medium	1.6	1.6	1.9
	High	1.9	1.9	2.2
Vineyard	Low	1.1	1.1	1.4
	Medium	1.4	1.4	1.7
	High	1.8	1.8	2.1

ATTACHMENT F

APPENDIX B METHOD FOR DETERMINING IF THERE IS A SIGNIFICANT IMPACT TO A NEIGHBORING WELL

The method for determining the amount of drawdown impact at neighboring wells is presented below.

1. Identify the distance to the nearest domestic and irrigation wells within one mile of the well serving the new water use. Well locations may be identified from published maps or from Google Earth images.
2. Use the Drawdown Calculator that will be placed on a SLO County webpage (at such time the program is adopted). This drawdown calculator estimates the amount of water level drawdown that is predicted to occur in each neighboring well using the Theis non-equilibrium equation (Theis, 1935) and estimated aquifer parameters for the area underlying the new use. The calculator is intended to make it easy to estimate water level drawdown at various distances with little previous hydrogeologic knowledge. The Theis equation used in the calculator is as follows:

$$s = \frac{114.6QW(u)}{T}$$

s = drawdown, in feet
Q = pumping rate, in gpm
T = Transmissivity, in gpd/ft
W(u) = well function of u

$$u = \frac{1.87r^2S}{Tt}$$

r = distance from pumped well to where s measured, in feet
S = storativity, dimensionless
t = time since pumping started, in days

Values for Theis W(u) can be found in
Driscoll, 1986

Aquifer parameter values used in the equation, including transmissivity (T) and storativity (S), are presented in Table 1 below. These values are automatically used in the Calculator when the user selects the subarea and the geologic unit tapped by the well where the new water use is located. The aquifer parameters used in the calculations were derived from Table 2 in the Paso Robles Groundwater Basin Report prepared by Fugro, 2005. Updated aquifer parameter values may be used whenever they become available.

TABLE 1 AQUIFER PARAMETER SUMMARY (FUGRO, 2005)			
Subarea	**Geologic Unit**	**Average Transmissivity**[(1)] (gpd/ft)	**Storativity**[(1)] (dimensionless)
Bradley	Alluvium and Paso Robles FM	52,800	na
	Paso Robles FM	8,000	na
Creston	Alluvium (Huer Huero Creek)	104,000	na
	Paso Robles FM	7,800	0.003
Estrella	Alluvium and Paso Robles FM	22,400	0.0004
	Paso Robles FM	4,600	0.003
Shandon	Paso Robles FM	11,000	0.003
San Juan	Paso Robles FM	35,000	0.003
North and South Gabilan	Paso Robles FM	5,600	0.003
NOTES: (1) from Fugro (2005), except Bradley from Fugro (2002); (2) geometric mean of range reported by Fugro (2005)			

Because the impact of water level drawdown on neighboring wells caused by an increase in pumping rate or volume is of interest, the value for the average pumping rate (Q) used in the equation is the difference between the historical pumping rate and the new pumping rate. If the new water use is from a new well that has had no historical pumping, then the average pumping rate equals the total new rate. The average pumping rate (Q) at the well serving the new use is calculated by multiplying the instantaneous maximum pumping rate (gpm) by the number of hours the well will be operated per day and dividing by 24 hours. The calculator will include an appropriate range of pumping rate and operation hours that are typically needed to serve the new use (e.g., irrigation of grapes in the summer).

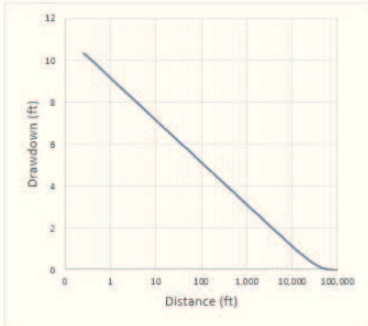
As illustrated below in the Drawdown Calculator, the process involves the following steps:

1) Identify the subarea the well serving the new water use is located (e.g., Shandon);
2) Select the geologic unit the well is completed in (e.g., if well is less than 200 feet deep, assume the well is completed in alluvium. If the well is greater than 200 feet deep, assume it is completed in the Paso Robles Formation);
3) Enter the new instantaneous pumping rate and the historical instantaneous pumping rate of the well serving the new use;
4) Enter the average number of hours per day the well is pumped; and,
5) Enter the distance the neighboring wells are away (in feet [ft]). Repeat for each well located within 1 mile.

The Calculator then computes the water level drawdown that can be expected at the neighboring well. A screen shot of the water level Drawdown Calculator is shown below.

USER-DEFINED INPUT VALUES

DRAWDOWN CALCULATION AT NEAREST WELL		
Subarea	San Juan	
Geologic Unit	Paso Robles FM	
Transmissivity	35,000	gallons per day per foot (gpd/ft)
Storativity	0.003	dimensionless
Original Pumping:		
Instantaneous Puming Rate	400	gallons per minute (gpm)
Average Hours Pumping Per Day	8	hours
Average Pumping Rate Per Day	133	gpm
New Pumping:		
Instantaneous Puming Rate	800	gpm
Average Hours Pumping Per Day	8	hours
Average Pumping Rate Per Day	267	gpm
Distance from Well with Increased Pumping to Nearest Well	1,000	feet
Drawdown at Nearest Well =	**3.1**	**Feet**



1.

EXAMPLE OFFSET CREDIT APPLICATIONS

Example 1 – Crop Conversion on Same Property, Same Well

Farmer A wishes to take 100 acres of alfalfa on ground he owns in the Estrella area and convert the ground to vineyard. They then wishes to grow more grapes on adjacent lands he owns that have not been previously irrigated. They will be using the same well for both areas. How many additional acres of vineyard can he plant?

Answer:

This is a Category 1 Offset application. The average crop water requirement for alfalfa is 4.5 acre-feet per acre and the average crop water requirement for vineyard is 1.7 acre-feet per acre (see Table 2).

Step 1) Determine total amount of water available per year

> Review of aerial photos and other documentation shows that the 100 acres of alfalfa was irrigated in at least 1 out of the last 5 years
>
> 4.5 AF/Acre X 100 acres = 450 AF/yr total water available

Step 2) Determine how many acres of vineyard can be developed with an average water requirement of 1.7 AF/Acre

> 450AF/1.7AF = 264.7 total acres of vineyard

Farmer A will be allowed to grow grapes on his original 100 acres plus an additional 164.7 acres using 1.7 acre-feet per acre per year of water. No proximity criteria apply because he is using the same well and will be applying the water to contiguous land that he owns. A meter would be required to be installed on the well.

Example 2 – Crop Conversion on Contiguous Property, Same Landowner, Different Well

Farmer B wishes to take 100 acres of alfalfa on ground he owns in the Estrella area and convert the ground to vineyard. He then wishes to grow more grapes on contiguous ground he owns that has not been previously irrigated. He will be using a different well for both areas. The new well serving the new use is located 3000 feet from a domestic well and 1000 feet from an irrigation well. Farmer B plans to increase the instantaneous pumping rate at the well serving the new use from 800 gpm to 1200 gpm for 8 hours per day max use. How many additional acres of vineyard can he plant?

Answer:

This is a Category 2 Offset application because it is contiguous property owned by the same landowner and a second well will be used. The average crop water requirement for alfalfa is 4.5 acre-feet per acre and the average crop water requirement for vineyard is 1.7 acre-feet per acre (see Table 13).

Step 1) Determine total amount of water available per year

> Review of aerial photos and other documentation shows that the 100 acres of alfalfa was irrigated in at least 1 out of the last 5 years
>
> 4.5 AF/Acre X 100 acres = 450 AF/yr total water available

Step 2) Determine how many acres of vineyard can be developed with an average water requirement of 2.1 AF/Acre

> 450AF/1.7AF = 264.7 total acres of vineyard

Step 3) Determine the impact on the nearest domestic and irrigation well using the drawdown calculator:

> Consider the instantaneous flow rate at the new well will be increased from 800gpm to 1200gpm – net increase of 400 gpm for 8 hours per day
> Domestic well at 3000 feet: Drawdown = 9.8 feet 15’ Criteria met: yes/no
> Irrigation well at 1000 feet: Drawdown = 17.1 feet 30’ Criteria met: yes/no

Farmer B will be allowed to grow grapes on his original 100 acres plus an additional 164.7 acres using 1.7 acre-feet per acre per year of water. If the properties are two legal parcels of record, deed covenants will be required to be recorded for each parcel. Meters would be required to be installed on the well serving the new use and the well that is the source of the offset credit. Proximity criteria for impacts on neighboring wells have been met.

**Note that drawdown impact criteria (15 feet) at a domestic well would not be met if the pumping duration was 12 hours, rather than 8 hours. Offset Distance criteria does not apply because the offset credit is derived from contiguous property.

Example 3 – Crop Conversion on Contiguous Property, Different Landowner, Different Well

This example is identical to #2 except that the adjacent contiguous land is owned by a different landowner. Assuming all assumptions remain the same, Farmer C would be granted an offset clearance for 164.7 acres and would be required to record a deed covenant his land and the neighbors land. Meters would be required to be installed on the well serving the new use and the well that is the source of the offset credit.

Example 4 – New Irrigation with an Offset Credit from a Different Landowner

Farmer D wishes to drill a new well to irrigate 500 acres of new vineyards on ground that was previously unirrigated near Creston. The new well is located 3000 feet from a domestic well and 1000 feet from an irrigation well. Farmer D plans to pump the well at an instantaneous rate of 800 gpm for 8 hours per day max use. The well serving the new use is not located within the area that SLO County has determined is a severe depletion area (greater than 50 feet of GW level decline). Farmer D has an agreement with Farmer E to provide an offset credit by fallowing 200 acres of irrigated pasture land in Shandon that has been irrigated by a well located 3 miles away. Will an offset clearance be granted and how many additional acres of vineyard can Farmer D plant?

Answer:
This is a Category 4 Offset application. The average crop water requirement for irrigated pasture is 6 acre-feet per acre and the average crop water requirement for vineyard is 1.7 acre-feet per acre (see Table 13).
Step 1) Determine total amount of water that the offset credit provides:

> Review of aerial photos and other documentation shows that the 200 acres of pasture was irrigated in at least 1 out of the last 5 years
>
> 6 AF/Acre X 200 acres = 1200 AF/yr total offset credit water available

Step 2) Determine how many acres of vineyard can be irrigated:
> 1200 AF divided by 1.7 AF/yr = 705.9 acres of vineyard

Step 3) Determine the impact on the nearest domestic and irrigation well using the drawdown calculator:
> Domestic well at 3000 feet: Drawdown = 13.8 feet 15' Criteria met: <u>yes</u>/no
> Irrigation well at 1000 feet: Drawdown = 27.9 feet 30' Criteria met: <u>yes</u>/no

Step 4) Determine the Maximum Offset Distance using the Offset Distance Calculator
> Cone of depression radius where the drawdown is greater than 2 foot = 16,800 feet (3.2 miles)
> Criteria met: <u>yes</u>/no

Based on the assumptions used in this example, Farmer D would be granted the offset clearance for 500 acres of new vineyards irrigated at 1.7 acre-feet per acre per year. The residual credit will not be counted unless a new application is submitted that utilizes this credit. Both Farmer D and E would be required to record deed covenants for the new irrigated parcel and the parcel providing the offset credit. Meters would be required to be installed on the well serving the new use and the well that is the source of the offset credit.

APPENDIX C METHOD FOR DETERMINING ACCEPTABLE PROXIMITY OF AN OFFSET CREDIT

The methodology used for computing the radial distance away from the well serving the new use where a Category 4 offset may be applied is presented below. It is based on the same Theis non-equilibrium equation described previously for the neighboring well impact evaluation and the estimated aquifer parameters for each sub area presented in Table 1. The steps are listed below:

1. Use the Offset Distance Calculator that will be placed on a SLO County webpage (at such time the program is adopted). This Offset Distance Calculator estimates the maximum distance the offset location (e.g., well) must be in order to be within the cone of depression formed by the well serving the new use where there is at least 2 feet of drawdown in the aquifer. The calculator is intended to make it easy to estimate the acceptable maximum distance that the offset credit can be from the well serving the new use, with little previous hydrogeologic knowledge.
2. As shown below, the user will select the subarea that the well serving the new water use is located (e.g., Shandon) and the geologic unit the well is completed in (e.g., Paso Robles Formation if the well is greater than 200 feet deep and alluvium if it is less than 200 feet deep).
3. Enter the instantaneous pumping rate for the well and the number of hours per day that the well will be operated. The Calculator will calculate the average pumping rate (Q) at the well serving the new use by multiplying the instantaneous maximum pumping rate (gpm) by the number of hours the well will be operated per day and dividing by 24 hours.
4. The Calculator then computes the radial distance the offset credit well must fall within in order to meet this proximity requirement. Offset credits may not be allowed in cases where there is a documented barrier to groundwater movement (e.g., fold or fault) that exists between the new groundwater use and the offset credit. A screen shot of the Offset Distance Calculator is shown below.

USER-DEFINED INPUT VALUES

OFFSET DISTANCE CALCULATION		
(1) Subarea	Creston	
(2) Geologic Unit	Paso Robles FM	
Transmissivity	7,800	gallons per day per foot (gpd/ft)
Storativity	0.003	dimensionless
(3) Instantaneous Pumping Rate	1200	gallons per minute (gpm)
(4) Average Hours Pumping Per Day	8	hours
Average Pumping Rate Per Day	400	gpm
Distance from Existing Well =	**19,600**	**feet**

How to Use the Offset Distance Calculator

(1) Subarea - Select the subarea location that the well serving the new water use is located (e.g., Creston) by clicking on the cell and using the drop-down menu provided.

(2) Geologic Unit - Select the geologic unit that the well serving the new water use is completed (e.g., Paso Robles FM) by clicking on the cell and using the drop-down menu provided.

(3) Instantaneous Pumping Rate - In the space provided, enter the instantaneous pumping rate (in gallons per minute) for the well.

(4) Average Hours Pumping Per Day - In the space provided, enter the average number of hours per day that the well will be operated.

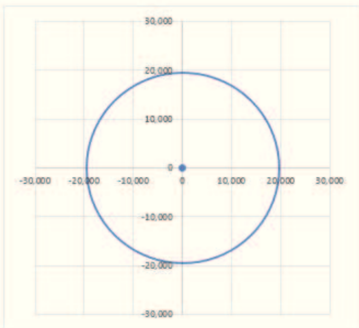


Figure 2 is a map that shows two examples of the offset distance calculation in different parts of the basin (Well X and Well Y). The circles represent the computed distance away from the well serving the new use where the water level drawdown is 2 feet. An offset credit well that falls within these circles meets the Category 4 proximity criteria. The Well X circle is bigger than the Well Y circle because the aquifer near Well Y is more permeable and the planned average pumping rate is lower at Well Y than at Well X.

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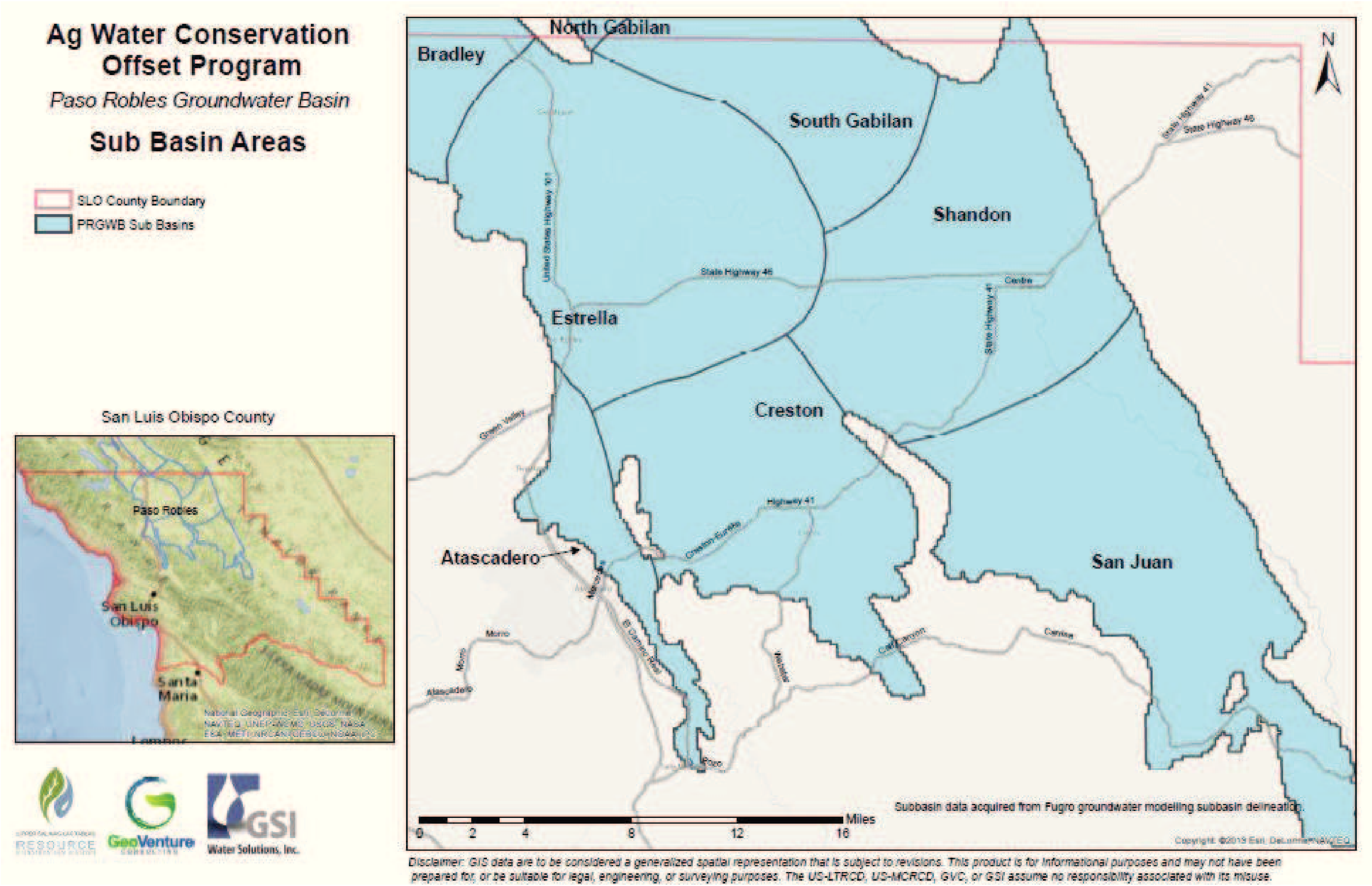
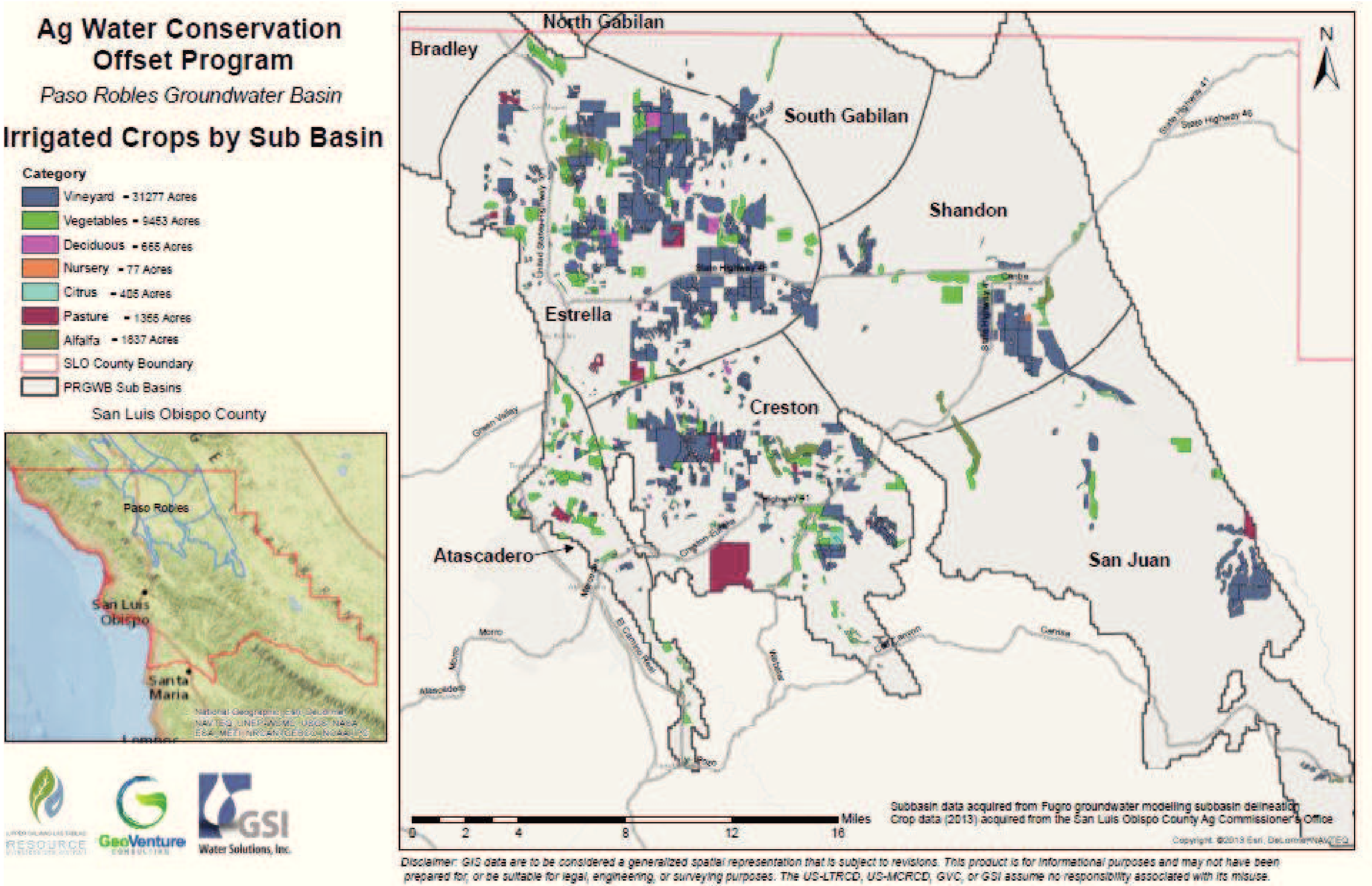
ATTACHMENT F

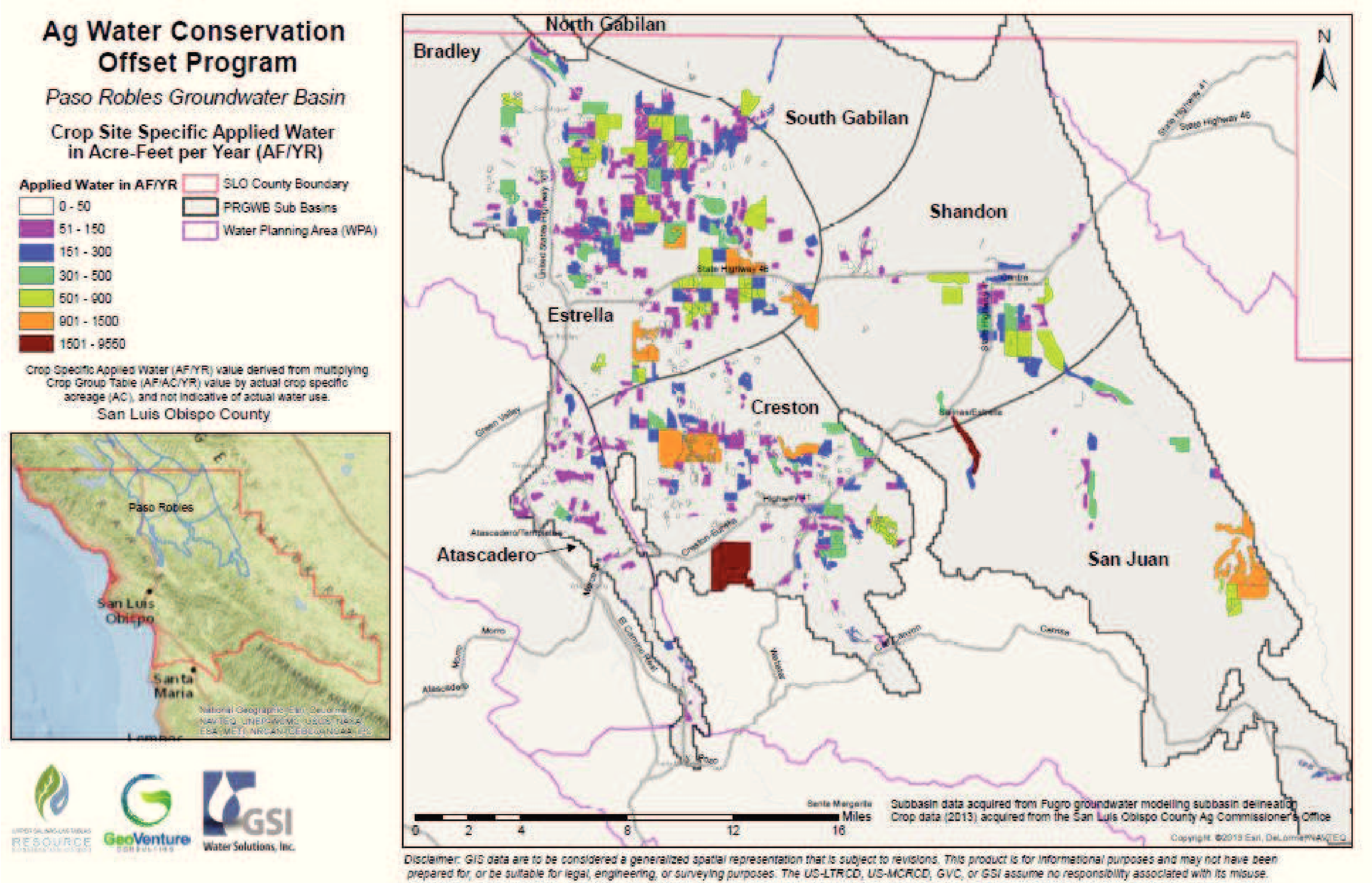
ATTACHMENT F

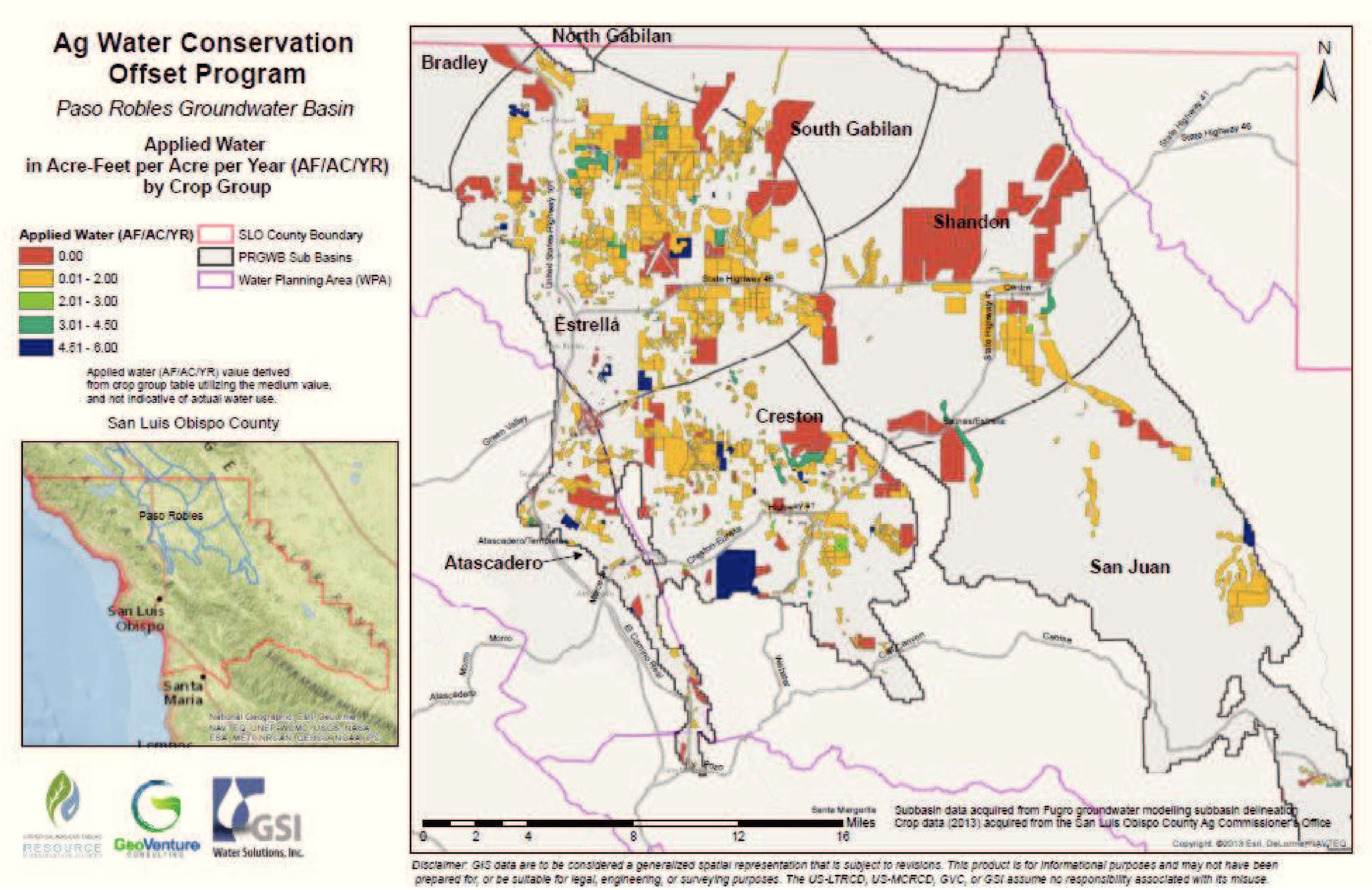
1.

Appendix D


Ag Water Conservation Offset Program
Paso Robles Groundwater Basin
Sub Basin Areas
SLO County Boundary
PRGWB Sub Basins
San Luis Obispo County
Paso Robles
San Luis Obispo
Santa Maria
North Gabilan
Bradley
South Gabilan
Shandon
Estrella
Creston
Atascadero
San Juan
State Highway 46
United States Highway 101
State Highway 41
Highway 41
El Camino Real
Miles
0 2 4 8 12 16
Subbasin data acquired from Fugro groundwater modelling subbasin delineation.
N
GeoVenture
GSI
Water Solutions, Inc.
Disclaimer: GIS data are to be considered a generalized spatial representation that is subject to revisions. This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. The US-LTRCD, US-MCRCD, GVC, or GSI assume no responsibility associated with its misuse.


Ag Water Conservation Offset Program
Paso Robles Groundwater Basin
Irrigated Crops by Sub Basin
Category
Vineyard - 31277 Acres
Vegetables - 9453 Acres
Deciduous - 666 Acres
Nursery - 77 Acres
Citrus - 405 Acres
Pasture - 1365 Acres
Alfalfa - 1637 Acres
SLO County Boundary
PRGWB Sub Basins
San Luis Obispo County
Paso Robles
San Luis Obispo
Santa Maria
GeoVenture
GSI
Water Solutions, Inc.
North Gabilan
Bradley
South Gabilan
Shandon
Estrella
Creston
Atascadero
San Juan
N
Miles
0 2 4 8 12 16
Subbasin data acquired from Fugro groundwater modelling subbasin delineation
Crop data (2013) acquired from the San Luis Obispo County Ag Commissioner's Office
Disclaimer: GIS data are to be considered a generalized spatial representation that is subject to revisions. This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. The US-LTRCD, US-MCRCD, GVC, or GSI assume no responsibility associated with its misuse.


Ag Water Conservation Offset Program
Paso Robles Groundwater Basin
Crop Site Specific Applied Water in Acre-Feet per Year (AF/YR)
Applied Water in AF/YR
0 - 50
51 - 150
151 - 300
301 - 500
501 - 900
901 - 1500
1501 - 9560
SLO County Boundary
PRGWB Sub Basins
Water Planning Area (WPA)
Crop Specific Applied Water (AF/YR) value derived from multiplying Crop Group Table (AF/AC/YR) value by actual crop specific acreage (AC), and not indicative of actual water use.
San Luis Obispo County
Paso Robles
San Luis Obispo
Santa Maria
North Gabilan
Bradley
South Gabilan
Shandon
Estrella
Creston
Atascadero
San Juan
N
Miles
0 2 4 8 12 16
Subbasin data acquired from Fugro groundwater modelling subbasin delineation
Crop data (2013) acquired from the San Luis Obispo County Ag Commissioner's Office
GeoVenture
GSI
Water Solutions, Inc.
Disclaimer: GIS data are to be considered a generalized spatial representation that is subject to revisions. This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. The US-LTRCD, US-MCRCD, GVC, or GSI assume no responsibility associated with its misuse.


Ag Water Conservation Offset Program
Paso Robles Groundwater Basin
Applied Water
in Acre-Feet per Acre per Year (AF/AC/YR)
by Crop Group
Applied Water (AF/AC/YR)
0.00
0.01 - 2.00
2.01 - 3.00
3.01 - 4.50
4.51 - 6.00
SLO County Boundary
PRGWB Sub Basins
Water Planning Area (WPA)
Applied water (AF/AC/YR) value derived from crop group table utilizing the medium value, and not indicative of actual water use.
San Luis Obispo County
Paso Robles
San Luis Obispo
Santa Maria
North Gabilan
Bradley
South Gabilan
Shandon
Estrella
Creston
Atascadero
San Juan
State Highway 46
State Highway 41
N
Miles
0 2 4 8 12 16
Subbasin data acquired from Fugro groundwater modelling subbasin delineation
Crop data (2013) acquired from the San Luis Obispo County Ag Commissioner's Office
GeoVenture
GSI
Water Solutions, Inc.
Disclaimer: GIS data are to be considered a generalized spatial representation that is subject to revisions. This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. The US-LTRCD, US-MCRCD, GVC, or GSI assume no responsibility associated with its misuse.

ATTACHMENT F

Fee Deposit: **$______________________** **Receipt No:** ____________________________	**Date:**	**Offset Category:** ☐ **Category 1** ☐ **Category 2** ☐ **Category 3** ☐ **Category 4**

TO BE COMPLETED BY APPLICANT	
APPLICANT INFORMATION	
Name:	**Organization, if applicable:**
Address:	
Phone Number:	**Email Address:**

CREDIT LOCATION	
☐ **On Same Property** **APNs:**	☐ **Not Adjacent, Within Same Sub-Area (Same Owner):** **APNs:**
☐ **On Adjacent Property (Same Owner)** **APNs:**	☐ **Not Adjacent, Within Same Sub-Area (Different Owner)** **APNs:**
☐ **On Adjacent Property (Different Owner)** **APNs:**	

PROJECT TYPE		
☐ **New irrigated agriculture**	☐ Expanded irrigated Agriculture	☐ Non-exempt rural residential landscaping

LANDOWNER SIGNATURES

This needs to be a section where we have some liability statements, acknowledgement of fees for services rendered, permit expiration deadlines, etc.

ATTACHMENT F

I (we) the undersigned owner of record of the fee interest in the parcel of land located at (print address): ____, identified as Assessor Parcel Number ____, for which a water offset use permit, is being filed with the County requesting an approval for entrance in the Water Offset Program

1. Such application may be filed and processed with my (our) full consent, and that I (we) have authorized the agent named below to act as my (our) agent in all contacts with the county and to sign for all necessary permits in connection with this matter.

2. I (we) hereby grant consent to the County of San Luis Obispo, its officers, agents, employees, independent contractors, consultants, sub-consultants and their officers, agents, and employees to enter the property identified above to conduct any and all surveys and inspections that are considered appropriate by the inspecting person or entity to process this application. This consent also extends to governmental entities other than the county, their officers, agencies, employees, independent contractors, consultants, sub-consultants, and their officers agents or employees if the other governmental entities are providing review, inspections and surveys to assist the county in processing this application. This consent will expire upon completion of the project.

3. If prior notice is required for an entry to survey or inspect the property. Please contact:
Print
Name:____
Daytime Telephone
Number:____

4. I (we) hereby give notice of the following concealed or unconcealed dangerous conditions on the property:
____

PERSON OR ENTITY GRANTING CONSENT:
Print Name:
____
Print Address:
____
Daytime Telephone Number:
____

Signature of landowner:____
Date:________________

AUTHORIZED AGENT:
Print Name:
____
Print Address:
____
Daytime Telephone Number:
____

ATTACHMENT F

Signature of authorized agent:______________________________________
Date:_________________

PART 1: LOCATION RECEIVING OFFSET CREDIT (receiving property)			
Landowner:		**Daytime Phone:**	
Property Address:	**City:**	**Zip:**	
Mailing Address:	**City:**	**State:**	**Zip:**
Contact / Landowner Representative (if applicable):			
Mailing Address:	**City:**	**State:**	**Zip:**

PART 1A: EXISTING PROPERTY INFORMATION		
Property Size (Acres):	**APN(s):**	
Directions to site: (include gate codes as applicable)		
Current Use: ☐ **Irrigated permanent crop** ☐ **Irrigated rotational crop** ☐ **Dry-farm crop** ☐ **Non-irrigated, unplanted**	**Current Crop(s):** **(note acreage of each)**	**Proposed Crop(s):** **(note acreage of each)**
Type of irrigation system:	**Years in Production:**	

PART 1B: OFFSET GROUNDWATER WELL INFORMATION	
Latitude:	**Longitude:**
Directions to Well on Property. Include an aerial map with the application:	

Describe the well status, including the hydrogeologic strata. Attach construction log.				
Total Depth:		**Depth of Screened Interval:**		
Volume Extracted (AF):		**Years in Production:**		

PART 2: LOCATION PROVIDING OFFSET CREDIT (Granting Property)

Landowner 1:				
Contact:		**Title:**		
Street Address:		**City:**	**State:**	**Zip:**
APN:	**Current Crop:**	**Acres Planted:**	**Years in Production:**	
Type of Irrigation System:		**Mechanism Creating Credit:** ☐ Land Fallowed ☐ Crop Conversion ☐ Efficiency and/or Conservation Measures (See Part 9)		
Amount of Credit (AF):		**Offset Ratio Achieved:**		
Signature:		**Date:**		
Landowner 2:				
Contact:		**Title:**		
Street Address:		**City:**	**State:**	**Zip:**
APN:	**Current Crop:**	**Acres Planted:**	**Years in Production:**	
Type of Irrigation System:		**Mechanism Creating Credit:** ☐ Land Fallowed ☐ Crop Conversion ☐ Efficiency and/or Conservation Measures (See Part 9)		
Amount of Credit (AF):		**Offset Ratio Achieved:**		
Signature:		**Date:**		
Landowner 3:				
Contact:		**Title:**		

Street Address:	**City:**	**State:**	**Zip:**
APN:	**Current Crop:**	**Acres Planted:**	**Years in Production:**

Type of Irrigation System:	**Mechanism Creating Credit:** ☐ Land Fallowed ☐ Crop Conversion ☐ Efficiency and/or Conservation Measures (See Part 9)
Amount of Credit (AF):	**Offset Ratio Achieved:**
Signature:	**Date:**

*please provide additional copies of this sheet as necessary to capture all owners and parcels granting water offset credits for this project

PART 2a: GROUNDWATER WELL INFORMATION FROM CREDITOR(S)	
Latitude:	**Longitude:**
Directions to Well on Property. Include an aerial map with the application:	
Describe the well status, including the hydrogeologic strata. Attach construction log.	
Total Depth:	**Depth of Screened Interval:**
Volume Extracted (AF):	**Years in Production:**

PART 3. ATTACHMENTS		
☐ **Overview Map**	☐ **Property Map**	☐ **Well Documents**
☐ **Aerial Photograph (s)**	☐ **Production Records (tons/acre)**	☐ **Irrigation System Specifications**
☐ **Zone of Impact Study**	☐ **Letters of Approval**	☐ **Irrigation Evaluation Report**

☐ **Description of frost protection measures**	☐ **Irrigation Schedule**	☐ **Additional Documents**
☐ **Landowner Contracts**	☐ **Flow Meter Data**	☐ **Additional Documents**

PART 4. ADDITIONAL INFORMATION

Have any offset credits been registered for this property before? ☐ **Yes** ☐ **No**
If yes, identify the date, duration and amount of offset credits acquired.

Date:	**Duration:**	**Amount of Credits:**

Are there plans to apply for additional credits in the future? ☐ **Yes** ☐ **No**

If yes to above, state when and how much:

Comments:

PART 5. MONITORING AND REPORTING REQUIREMENTS

☐ **Annual Monitoring Reports**	**Flow Meter Log**	**Begin:**
		End:
	Volume Extracted (AF):	**Acres Planted:**
		Acres in Production:
	Current Crop:	**Date of Termination:**
☐ **Completion date**	**Will the offset terminate Y N**	**Date of Termination:**

*Upon receipt of a complete application package, a 60-day review period will commence. If an application is denied, the applicant has 30 days to revise and resubmit. An application that is denied after resubmittal will have a one-year waiting period to reapply. NOTE: Applications will become null and void if not issued within 6 months and applicant will need to resubmit and repay fees.